AMENDMENTS TO THE CLAIMS

Claims 1-32 (Canceled).

33. (New) A method of optimizing a waveform of an electrical current applied to an electrode, in order to remove a sulfur contaminant from the electrode, comprising the steps of:

(a) applying an electrical current to an electrode of a device;

(b) determining a waveform of the voltage or the current of the electrical current;

(c) representing the waveform by mathematical expressions or numbers;

(d) measuring a function of the device associated with the application of the electrical current; and

(e) varying the shape and frequency of the waveform to optimize the function of the device and thereby determine an optimized waveform of the electrical current to be applied to the electrode of the device;

(f) wherein the application of the electrical current is effective to remove the sulfur contaminant from the electrode.

34. (New) A method according to claim 33 wherein step (c) comprises representing the waveform by a mathematical description such as a number of points or an analytical function characterized by a number of unknown coefficients and a fixed number of known functions; and step (e) comprises feeding the waveform description and the measurements to an algorithm, which may be in a computer program or other calculating device including manual calculations, including an optimization routine which uses the points or coefficients as independent variables for optimizing the function of the device, and performing the calculations to determine values of the points or coefficients which optimize the function of the device, and thereby determine an optimized waveform of the electrical current to be applied to the electrode of the device.

35. (New) A method according to claim 33 wherein the electrode is an anode or cathode of a fuel cell, wherein the function is a current output, a power

output or a specified load which may vary in time of the fuel cell, and wherein the optimizing of the function is optimizing the net current or the net power produced by the fuel cell or the matching of the steady or time-varying load.

36. (New) A feedback control method of operating an electrochemical apparatus operated using a fuel containing a sulfur contaminant, in order to remove the sulfur contaminant from an electrode of the apparatus, the method comprising applying voltage control to the electrode using the following algorithm:

(a) determining a mathematical model that relates the instantaneous coverage of the fuel and the sulfur contaminant to the overvoltage applied to the electrode;

(b) forming an observer that relates the instantaneous coverage of the fuel and the sulfur contaminant to the measured current of the apparatus;

(c) driving the estimated sulfur contaminant coverage to a low value by varying the overvoltage;

(d) driving the estimated fuel coverage to a high value by varying the overvoltage; and

(e) repeating steps (a) through (d) as necessary.

37. (New) A method according to claim 36 wherein the algorithm includes the additional steps, after step (b), of:

(bi) prescribing a desired trajectory of the instantaneous coverage of the fuel and the sulfur contaminant as a function of time; and

(bii) forming a set of mathematical relationships from steps (a), (b) and (bi) that allows the current to be measured, the overvoltage to be prescribed and the instantaneous sulfur contaminant coverage and instantaneous fuel coverage to be predicted.

38. (New) A method according to claim 36 wherein the electrochemical apparatus is a fuel cell and the overvoltage is varied by changing the fuel cell voltage, current or external impedance.

39. (New) A method of removing a sulfur contaminant from an electrode comprising:

applying an electrical current to the electrode; and

pulsing the voltage of the electrical current during the application, such that the overvoltage at the electrode is high during the pulses, and the overvoltage at the electrode is low between the pulses;

where the electrode is an electrode of a fuel cell, or the electrode is part of an electrochemical cell located upstream of a fuel cell and the method removes the sulfur contaminant from a fuel or air stream before it enters the fuel cell.

40. (New) A method according to claim 39 wherein the electrode is an electrode of a fuel cell, and comprising an additional step of equipping the fuel cell with a voltage boosting circuit to change the high value of the overvoltage to a desired level.

41. (New) A method according to claim 39 where the energy for the pulsing comes from the output of a fuel cell or from external energy or from energy produced by the fuel cell and stored in a battery, capacitor or similar device, and is fed back to one or more cells to vary the voltage waveform to clean the sulfur contaminant and maintain the desired operating voltage, current or power.

42. (New) A method according to claim 39 wherein the steps of applying and pulsing are applied to both an electrode of a fuel cell and the electrode of an electrochemical cell located upstream of the fuel cell.